# Appendix A: Descriptive statistics and additional tests

**Table A1. Descriptive statistics**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | mean | sd. | min. | max. |
| CDR (deaths per 1,000 people) | 22.501 | 8.989 | 5.865 | 78.890 |
| CBR (births per 1,000 people) | 31.198 | 7.468 | 9.491 | 64.366 |
| forced labor (per 1,000 people) | 88.082 | 50.409 | 0.000 | 306.296 |
| production (tons per 1,000 people) | 15.210 | 16.647 | 0.000 | 90.501 |
| buffalo (per 1,000 people) | 177.448 | 76.203 | 22.655 | 440.934 |
| price rice (guilders per *picul*) | 2.685 | 1.378 | 0.830 | 11.840 |
| crop payment (guilders per 1,000 people) | 1403.814 | 1381.364 | 0.000 | 8949.026 |
| officials (per 1,000 people) | 0.022 | 0.016 | 0.000 | 0.096 |

*Sources*: Boomgaard and Gooszen (1991); Van Baardewijk (1994); *Koloniale Verslagen* (Colonial Reports) and *Kultuur Verslagen* (Cultivation Reports).

**Table A2. The impact of the Cultivation System on crude death rates using a lagged variable**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | | | (3) | | | (4) | | (5) | | (6) |
| log forced labor | 0.131\*\*\* | 0.189\*\*\* | | | 0.187\*\*\* | | | 0.160\*\* | | 0.159\*\* | | 0.217\*\*\* |
| (one-year lag) | (0.047) | (0.056) | | | (0.059) | | | (0.060) | | (0.067) | | (0.076) |
| log buffalo |  |  | | | -0.231\* | | | -0.258\* | | -0.224\* | | -0.150 |
|  |  |  | | | (0.135) | | | (0.129) | | (0.123) | | (0.103) |
| log production |  |  | | |  | | | 0.068\*\* | | 0.070\*\* | | 0.117\*\* |
|  |  |  | | |  | | | (0.028) | | (0.028) | | (0.046) |
| log rice price |  |  | | |  | | |  | | 0.034 | | 0.087 |
|  |  |  | | |  | | |  | | (0.060) | | (0.063) |
| log crop payment |  |  | | |  | | |  | |  | | -0.041 |
|  |  |  | | |  | | |  | |  | | (0.056) |
| officials |  |  | | |  | | |  | |  | | -3.319\* |
|  |  |  | | |  | | |  | |  | | (1.463) |
| Fixed effects | Yes | Yes | | | Yes | | | Yes | | Yes | | Yes |
| Year-fixed Effects | No | Yes | | | Yes | | | Yes | | Yes | | Yes |
| Observations | 537 | 537 | | | 536 | | | 535 | | 468 | | 393 |
| R2 | 0.28 | 0.45 | | | 0.46 | | | 0.47 | | 0.48 | | 0.52 |
| Driscoll-Kraay standard errors in parentheses | | | |  | |  |  | |  | |  | |
| \*p<0.10, \*\*p<0.05, \*\*\*p<0.01 | | |  | | |  |  | |  | |  | |

*Sources:* see Table 2.

**Table A3: The impact of the Cultivation System on crude death rates (interacting the price of rice with the percentage of rice area cultivated)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
| log forced labor | 0.121\*\* | 0.190\*\*\* | 0.191\*\*\* | 0.163\*\*\* | 0.146\*\* | 0.185\*\* |
|  | (0.045) | (0.055) | (0.057) | (0.060) | (0.069) | (0.080) |
| log buffalo |  |  | -0.193 | -0.224\* | -0.224 | -0.139 |
|  |  |  | (0.124) | (0.119) | (0.138) | (0.102) |
| log production |  |  |  | 0.062\*\* | 0.060\* | 0.106\*\* |
|  |  |  |  | (0.028) | (0.031) | (0.046) |
| log rice price |  |  |  |  | -0.170 | -0.062 |
|  |  |  |  |  | (0.198) | (0.198) |
| log rice price x perc. rice area |  |  |  |  | 0.262 | 0.194 |
|  |  |  |  |  | (0.218) | (0.216) |
| log crop payment |  |  |  |  |  | -0.044 |
|  |  |  |  |  |  | (0.060) |
| officials |  |  |  |  |  | -2.858\* |
|  |  |  |  |  |  | (1.667) |
| Fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Year-fixed Effects | No | Yes | Yes | Yes | Yes | Yes |
| Observations | 547 | 547 | 546 | 546 | 468 | 393 |
| R2 | 0.27 | 0.45 | 0.45 | 0.46 | 0.48 | 0.51 |
| Driscoll-Kraay standard errors in parentheses | | | |  |  |  |
| \*p<0.10, \*\*p<0.05, \*\*\*p<0.01 | |  |  |  |  |  |

*Notes:* The results were obtained estimating equation 1 using log crude death rates as dependent variable. All variables, except for *officials*, are log-transformed and the panel is unbalanced. Unlike the specifications used in Table 2, here we interact *price rice* with a continuous variable measuring the percentage of cultivated rice area over total arable land (*perc. rice area*).

*Sources:* see Table 2.

**Table A4: The impact of the Cultivation System on crude death rates (adding an interaction with a ‘coffee’ dummy)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | | (5) | (6) |
| log forced labor | 0.077 | 0.149\*\* | 0.132\*\* | 0.126\*\* | | 0.128\* | 0.146\* |
|  | (0.056) | (0.057) | (0.059) | (0.060) | | (0.071) | (0.079) |
| log forced labor x coffee | 0.085 | 0.080 | 0.116 | 0.092 | | 0.053 | 0.099 |
|  | (0.070) | (0.073) | (0.071) | (0.081) | | (0.087) | (0.078) |
| log buffalo |  |  | -0.227\* | -0.240\*\* | | -0.218 | -0.138 |
|  |  |  | (0.123) | (0.119) | | (0.132) | (0.106) |
| log production |  |  |  | 0.040 | | 0.053 | 0.076\* |
|  |  |  |  | (0.038) | | (0.034) | (0.043) |
| log rice price |  |  |  |  | | 0.036 | 0.093 |
|  |  |  |  |  | | (0.063) | (0.064) |
| log crop payment |  |  |  |  | |  | -0.028 |
|  |  |  |  |  | |  | (0.056) |
| officials |  |  |  |  | |  | -3.488\* |
|  |  |  |  |  | |  | (1.772) |
| Fixed effects | Yes | Yes | Yes | Yes | | Yes | Yes |
| Year-fixed Effects | No | Yes | Yes | Yes | | Yes | Yes |
| Observations | 547 | 547 | 546 | 546 | | 468 | 393 |
| R2 | 0.28 | 0.45 | 0.46 | 0.46 | | 0.47 | 0.51 |
| Driscoll-Kraay standard errors in parentheses | | | | |  |  |  |
| \*p<0.10, \*\*p<0.05, \*\*\*p<0.01 | |  |  | |  |  |  |

*Notes:* The results were obtained estimating equation 1 using log crude death rates as dependent variable. All variables, except for *officials*, are log-transformed and the panel is unbalanced. Unlike the specifications used in Table 2, here we interact our main independent variable (*log forced labour*) with a ‘coffee’ dummy, which becomes one for residencies with average coffee production shares above 50 percent over total production under the Cultivation System.

*Sources:* see Table 2.

**Table A5. The impact of forced labor on crude birth rates (robustness tests)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | | (4) |
| log forced labor | 0.006 | 0.017 | -0.001 | | 0.015 |
|  | (0.028) | (0.033) | (0.033) | | (0.025) |
| log buffalo | -0.002 | -0.007 | 0.061 | | -0.001 |
|  | (0.082) | (0.084) | (0.086) | | (0.079) |
| log production | 0.011 | 0.022 | 0.001 | | 0.000 |
|  | (0.029) | (0.030) | (0.028) | | (0.028) |
| Fixed effects | Yes | Yes | Yes | | Yes |
| Year-fixed Effects | Yes | Yes | Yes | | Yes |
| Observations | 555 | 520 | 528 | | 504 |
| R2 | 0.35 | 0.39 | 0.37 | | 0.42 |
| Driscoll-Kraay Standard errors in parentheses | | | |  |  |
| \*p<0.10, \*\*p<0.05, \*\*\*p<0.01 | | | |  |  |

Note: see table 4 for the sources. The results were obtained estimating equation 1 using log crude death rates as dependent variable. All variables, except for *officials*, are log-transformed and the panel is unbalanced. Column 1 refers to our findings in table 4, column 4; column 2 excludes Besuki from the sample; column 3 excludes years with the observed births per capita above 44 (95th percentile of *CBR*); and column 4 excludes periods of famine (1844-1846; 1849-1850).

**Table A6: The impact of the Cultivation System on crude death rates (controlling for CBR)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| log forced labor | 0.121\*\* | 0.190\*\*\* | 0.181\*\*\* | 0.181\*\*\* | 0.155\*\*\* | 0.125\*\* | 0.160\*\* |
|  | (0.045) | (0.055) | (0.046) | (0.049) | (0.054) | (0.051) | (0.059) |
| log CBR |  |  | 0.494\*\*\* | 0.497\*\*\* | 0.494\*\*\* | 0.525\*\*\* | 0.465\*\*\* |
|  |  |  | (0.085) | (0.085) | (0.088) | (0.088) | (0.098) |
| log buffalo |  |  |  | -0.216\* | -0.244\*\* | -0.229\* | -0.147 |
|  |  |  |  | (0.114) | (0.113) | (0.128) | (0.108) |
| log production |  |  |  |  | 0.057\* | 0.066\*\* | 0.105\*\* |
|  |  |  |  |  | (0.030) | (0.030) | (0.049) |
| log rice price |  |  |  |  |  | 0.034 | 0.080 |
|  |  |  |  |  |  | (0.070) | (0.075) |
| log crop payment |  |  |  |  |  |  | -0.036 |
|  |  |  |  |  |  |  | (0.053) |
| officials |  |  |  |  |  |  | -2.244\*\* |
|  |  |  |  |  |  |  | (1.085) |
| Fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year-fixed Effects | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 547 | 547 | 541 | 540 | 540 | 462 | 387 |
| R2 | 0.27 | 0.45 | 0.53 | 0.54 | 0.54 | 0.56 | 0.57 |
| Driscoll-Kraay standard errors in parentheses | | | |  |  |  |  |
| \*p<0.10, \*\*p<0.05, \*\*\*p<0.01 | |  |  |  |  |  |  |

*Notes:* The results were obtained estimating equation 1 using log crude death rates as dependent variable. All variables, except for *officials*, are log-transformed and the panel is unbalanced. The difference between this table and Table 2 is that we include log CBR (Crude Birth Rates) as a control variable here.

*Sources:* see Table 2.

**Table A7: Residencies and their placement in crop category for IV.**

| **Residency** | **Crop category** |
| --- | --- |
| Bagelen | Coffee |
| Banten | Coffee |
| Banyumas | Coffee |
| Besuki | Sugar |
| Jepara | Sugar |
| Kediri | Sugar |
| Kedu | Coffee |
| Krawang | No category |
| Madiun | Coffee |
| Pasuruan | Sugar |
| Pekalongan | Sugar |
| Priangan | Coffee |
| Rembang | No category |
| Semarang | Sugar |
| Surabaya | Sugar |
| Tegal | Sugar |

**Table A8: The impact of the Cultivation System on crude birth rates (IV estimates)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | (1) | | (2) | | (3) | |
| *Panel A: Second Stage* | |  | |  | |
| log forced labor | -0.162\* | | -0.011 | | -0.146 | |
|  | (0.095) | | (0.110) | | (0.179) | |
| *Panel B: First Stage (dep. var. log forced labor)* | | | | | |
| log Amsterdam prices | -0.391\*\*\* | | -0.322\*\*\* | | -0.259\*\*\* | |
|  | (0.072) | | (0.071) | | (0.097) | |
| F-statistic on excluded instrument | 29.91 | | 20.46 | | 7.11 | |
|  |  | |  | |  | |
| Province and year fixed effects | Yes | | Yes | | Yes | |
| Buffalos | Yes | | Yes | | Yes | |
| Rice price | No | | Yes | | Yes | |
| Crop payments | No | | No | | Yes | |
| Officials | No | | No | | Yes | |
| Observations | 482 | | 413 | | 344 | |
| Driscoll-Kraay standard errors in parentheses | | | |  | |
| \*p<0.10, \*\*p<0.05, \*\*\*p<0.01 | |  | |  | |

*Notes*: see table 4 for the sources. All variables, except for *officials*, are log-transformed. The results for panel A were obtained estimating equation 3 using log births per capita as dependent variable and excluding the residencies of Krawang and Rembang. The results for Panel B were obtained estimating equation 2. The report F-statistic on the excluded instrument refers to the Sanderson-Windmeijer statistic.

# Appendix B: Database construction

When inspecting the data, a number of implausible observations were noted. These were transcription errors in either the *Koloniale Verslagen* or *Kultuur Verslagen*. The data points corrected are listed in table B1 below.

**Table B1. Corrections to original CEI and KV data.**

| **Residency** | **year** | **variable** | **decision** |
| --- | --- | --- | --- |
| Pekalongan | 1847 | births | interpolated |
| Tegal | 1847 | births | interpolated |
| Bagelen | 1834 | forced labor | removed |
| Priangan | 1834 | forced labor | removed |

As a robustness check to under-reporting, we have also adjusted a number of series for trend breaks that were due to corrections made by the colonial government and re-estimated the regressions. We adjusted the series by increasing all observations prior to the trend break by the percentage increase at the year of the trend break. The changes are listed below in table B2 below and the regression estimates can be found in table B3.

**Table B2. Trend corrections to original CEI data for robustness checks.**

| **Residency** | **year** | **variable** |
| --- | --- | --- |
| Banyumas | 1869 | population-deaths-births |
| Banyumas | 1862 | population-deaths-births |
| Banyumas | 1861 | population-deaths-births |
| Banyumas | 1860 | population-deaths-births |
| Kedu | 1867 | population-deaths-births |
| Pekalongan | 1868 | population-deaths-births |
| Pekalongan | 1860 | population-deaths-births |

**Table B3. The impact of the Cultivation System on crude death rates (robustness check based on data corrected for trend breaks)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
| log forced labor | 0.130\*\*\* | 0.202\*\*\* | 0.204\*\*\* | 0.177\*\*\* | 0.161\*\* | 0.188\*\* |
|  | (0.043) | (0.054) | (0.054) | (0.058) | (0.064) | (0.075) |
| log buffalo |  |  | -0.144 | -0.171\* | -0.150 | -0.094 |
|  |  |  | (0.103) | (0.100) | (0.113) | (0.095) |
| log production |  |  |  | 0.061\*\* | 0.067\*\* | 0.099\*\* |
|  |  |  |  | (0.026) | (0.026) | (0.039) |
| log rice price |  |  |  |  | 0.046 | 0.100 |
|  |  |  |  |  | (0.063) | (0.062) |
| log crop payment |  |  |  |  |  | -0.029 |
|  |  |  |  |  |  | (0.056) |
| officials |  |  |  |  |  | -3.015\* |
|  |  |  |  |  |  | (1.646) |
| Fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Year-fixed Effects | No | Yes | Yes | Yes | Yes | Yes |
| Observations | 547 | 547 | 546 | 546 | 468 | 393 |
| R2 | 0.28 | 0.45 | 0.46 | 0.46 | 0.48 | 0.51 |
| Driscoll-Kraay standard errors in parentheses | | | |  |  |  |
| \*p<0.10, \*\*p<0.05, \*\*\*p<0.01 | |  |  |  |  |  |

*Notes:* The results were obtained estimating equation 1 using log crude death rates as dependent variable. All variables, except for *officials*, are log-transformed and the panel is unbalanced. The difference between these results and those from table 2 in the text stem from the data adjustments listed in table B2.

*Sources:* see figure 4.

**Figure B1. Population (line) and population reconstructed from births and deaths (circles) by residency, 1834–1879.**

